Modeling, VR, & Videogames: Applications for a Healthier Force

Program Officer
Biological and Medical Science & Technology Division
Office of Naval Research

Overview

Two Program Areas:

- **Casualty Prevention**
  - *Counter threats from disease battle and non-battle injuries*
- **Healthy and Fit Force**
  - *Reduce and prevent injury in day-to-day operations and promote the health and well-being of the Warfighter*

Casualty Prevention

Current Casualty Prevention Products:

- Eye protection against agile laser threats and laser incident detection
- Diving/damage control/firefighting/aircrew suits
- Blunt trauma and thermobaric injury models
- Noninvasive technologies for disease detection
- Protection against effects of environmental stressors

Healthy & Fit Force

Current HFF Products

- Improved Hearing Protection for Flight Deck Crew
  - *Develop 50dB+ Hearing Protection*
- Antioxidant therapies for preventing and reversing hearing loss
  - *CRADA with American Biohealth and NanoBioMagnetics*
- Prevention of Neck Injury
  - *Understand injury mechanisms associated with shock and ejection*

Neck & Spinal Modeling

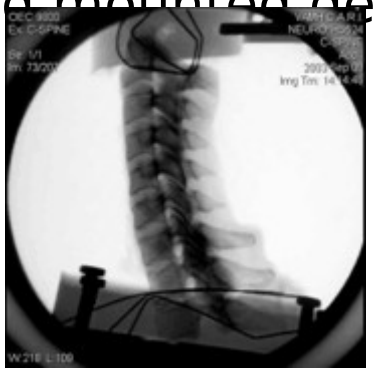
Product Description:

- Determine neck and spine injury tolerance during maneuvering and acceleration.

- Characterize cervical vertebral mechanical properties, head/neck/spine movements, isometric and dynamic strength/endurance, and tolerance to head borne loads and work-rest cycles.

- Provide design guidelines for head mounted devices/system.

Flexion



Extension

Performer: NAVAIR (NAWCAD)

Blunt Trauma & Thermobaric Weapons Effect Modeling

Product Description:

- Physical and finite element models
- Human torso
- Simulate effects on internal organs of
  - blunt trauma
  - blast
- **Performer:** Johns Hopkins

Emerging Areas of Interest

- Warfighter Mental Health
  - Deployed Interventions and Treatments
  - Virtual Reality Therapy
- Spatial Disorientation
- Neurological Effects of Blast
  - Understand the mechanisms of neurological injury
  - Tie damage to cognitive/motor/emotional deficits
  - Possible DARPA collaboration
- Head, Face, & Neck Protection
  - What types of protection are needed and how can they be implemented w/o hampering the warfighter?
  - Not looking at material solutions!

Emerging Areas of Interest

- Prediction of Heat Casualties
  - Criteria for returning heat casualties to duty
- Musculoskeletal Injury
- Agent-based decision support tools for medical
  - How can human behavior be modified to reduce disease spread?
- Training aids for medics and first responders
  - CD-Based tool?
  - Game-engine based simulation?
  - Must be deployable
  - Ideas from Program Officer's work on "America's Army" videogame prior to ONR assignment

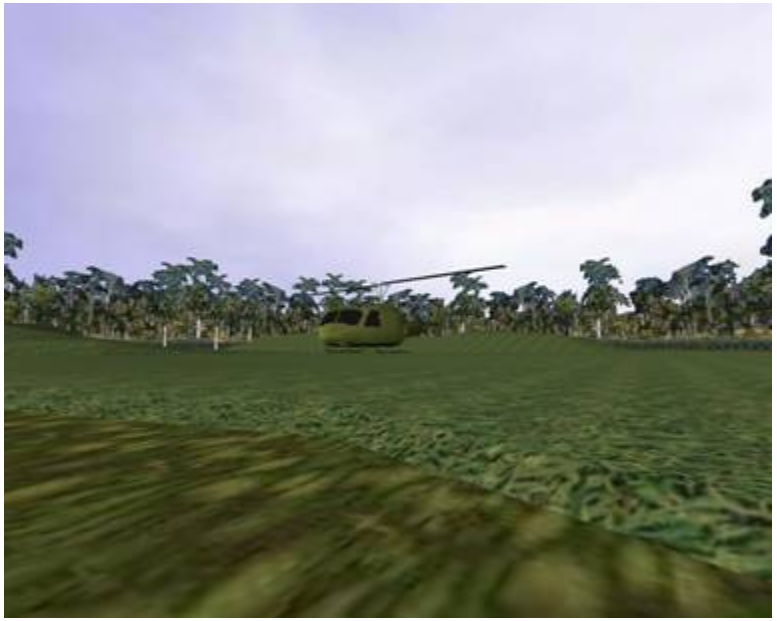
Warfighter Mental Health

- VR as a psychological tool
  - Phobia
    - Acrophobia
    - Fear of flying
  - Panic Disorder
  - PTSD
    - How about combat stress??
  - Pain Control

How has Virtual Reality Been Applied Effectively in Therapy?

Background: PTSD Therapy for Vietnam Vets (1999)

- Virtual Vietnam
  - Exposure Therapy
  - Developed by a team lead by Larry Hodges
  - Treating Vietnam Vets



Background: World Trade Center Application (2002)

- U. of Washington HITlab in Seattle
- Treatment of PTSD in World Trade Center survivor
- Significant reduction in symptoms
- Are details important in VR Therapy or distracting??

Background: Videogame Interface (2004)

- **University of Southern California Integrated Media Systems Center**
- Using Videogame graphics and "Wizard of Oz" Control Interface

Background: Israeli Bus Bombing Work (2004)

- U. of Washington HITlab in Seattle
- Funded and supported by
  - U of Haifa
  - Paul Allen Foundation
- Discussed in Sci Am (Aug 2004)

INTERESTING: Pain Control (2004)

- U. of Washington HITlab in Seattle
- Funded and supported by
  - Paul Allen Foundation
- Data backed by fMRI data!

Potential Research Plan and Goals

- Develop scenarios and therapy strategy to treat active duty military serving in Iraq and Afghanistan
- Early Intervention
- Possible tool for diagnosis as well as treatment
- Three-pronged research Strategy….

Possible Strategy for Developing a VR Therapy System

1. Using the same high-end VR tools that have been used in these systems in the past, develop and validate strategies for early intervention for combat stress and PTSD

2. Develop and assess effectiveness of a low-cost system for possible deployment and wide-spread use

3. Have Both Systems Evaluated And Scenarios Developed By Top Experts in Treatment

Why an Agent-Based Modeling Tool?

- In February 2003, Severe Acute Respiratory Syndrome (SARS) spread quickly around the world
- Avian influenza outbreaks have been increasing throughout China and have crossed to humans
  - When avian flu crosses to humans, the results can be catastrophic
  - 1918 Spanish Flu was one such virus
    - 20-40 Million killed worldwide
    - 500- 600k fatalities in U.S.
    - Devastating military impact in WWI to both sides
    - British Fleet had to be docked for 12 days
- Common outbreaks of diarrheal disease and other infections are common and have significant impact on readiness
- Manipulating Human Behavior is often one of the BEST methods for controlling disease spread, yet we have no tools available to the medical officer.

Agent-Based Modeling Tool for Medical Department Shipboard Use

Goal:

- Develop a tool that can be used in the medical department that allows the Medical Officer predict the spread of naturally occurring diseases onboard Navy vessels
- Take into account human behavior
- Must be easy to use
- Use as a planning tool and to develop strategies for quarantine, disease control, and medical workload

Training Aids for Medics and First Responders

- What can we do to help our warfighters better cope with treating wounds and injuries while in combat?
- Use game technology and traditional CDROM technologies to help educate and refresh lessons on basic combat first-aid
- One concept developed last year by myself and one of my graduate students at NPS was to look at the 8 “ GITMO Wounds”
- A current product would aim at helping train the types of wounds most commonly seen and treated
- Could be aimed at the average warfighter or at the medic level
- Make the player learn and demonstrate the appropriate skills
- OEM PC / laptop based

Story Board Concept
NPS Graduate Student

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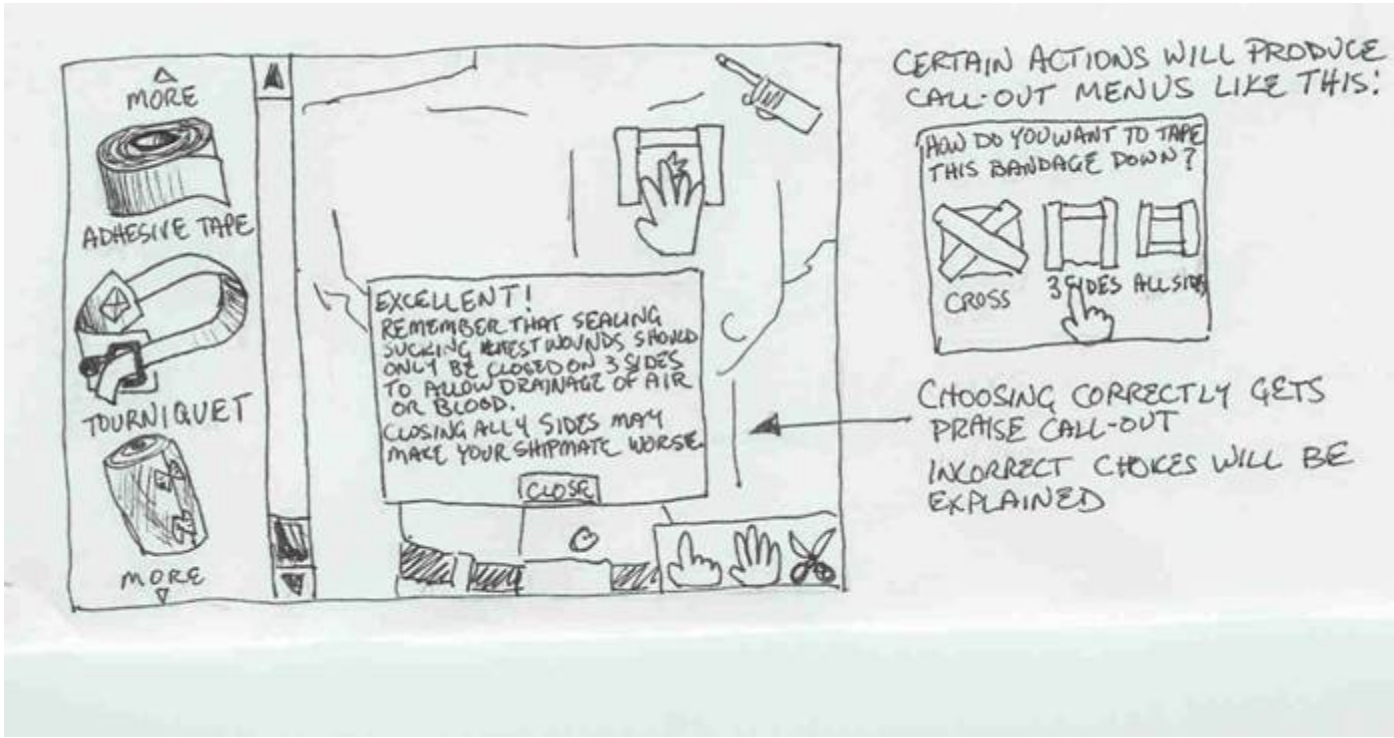
NPS Graduate Student


MORE
ADHESIVE TAPE
TOURNIQUET
MORE
EXCELLENT!
REMEMBER THAT SEALING SUCKING CHEST WOUNDS SHOULD ONLY BE CLOSED ON 3 SIDES TO ALLOW DRAINAGE OF AIR OR BLOOD.
CLOSING ALL 4 SIDES MAY MAKE YOUR SHIPMATE WORSE
CLOSE
CERTAIN ACTIONS WILL PRODUCE CALL-OUT MENUS LIKE THIS:
HOW DO YOU WANT TO TAPE THIS BANDAGE DOWN?
CROSS
3 SIDES
ALL SIDES
CHOOSING CORRECTLY GETS PRAISE CALL-OUT
INCORRECT CHOICES WILL BE EXPLAINED

AMERICA'S ARMY GAME

AMERICA'S ARMY GAME

National Center for Collaboration in Medical Modeling and Simulation

- Congressionally Funded
- Joint Program Between
  - Eastern Virginia Medical School
  - Old Dominion University
- Validation studies for VR Effectiveness
- Database for tracking M&S Medical Technology
- To strengthen medical and health professions training in both military and civilian programs through the introduction and evaluation of new modeling and simulation technology

National Center for Collaboration in Medical Modeling and Simulation
VR Catheterization Simulator:

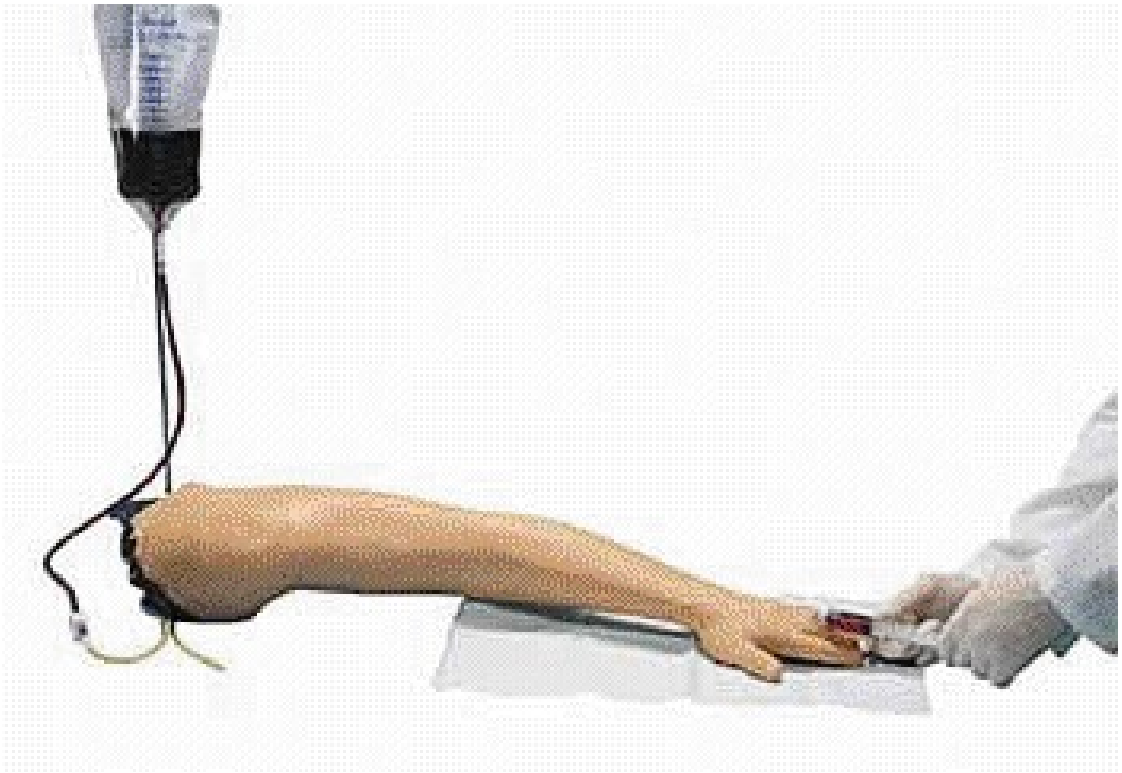
The CathSim™ system by Immersion Medical, Inc.

National Center for Collaboration in Medical Modeling and Simulation
Simulator Validation Studies: Objectives

- To compare VR simulation and traditional methods using simulated limbs for teaching common medical procedures (IV catheterization and phlebotomy)

- To compare VR simulation and traditional supervised training for teaching a surgical procedure (lower GI endoscopy, arthroscopy)

Life/Form® simulated limb



National Center for Collaboration in Medical Modeling and Simulation IV Catheterization Study:

- Participants – 16 students in the Master's of Physician Assistant program at EVMS and 20 EVMS medical students
- Training – Participants worked in teams of two and were given 2 hours of training. Half of the participants trained on the simulated limb and the other half on the VR system
- All participants were given a pretest and posttest on the simulated limb and performance was evaluated with a standardized assessment form

National Center for Collaboration in Medical Modeling and Simulation IV Catheterization Study:

- All participants improved under both training methods, (i.e. they performed better on the posttest than on the pretest), but...
- Better performance was observed with the simulated limb over the VR system
- The lower scores obtained with the VR system may be because the system does not faithfully reproduce *all* of the steps needed to perform the complete procedure

National Center for Collaboration in Medical Modeling and Simulation
Ongoing Validation Studies:

- Additional validation studies of the catheterization simulator are ongoing with the Uniformed Services University of the Health Sciences and a second cohort of EVMS/ODU students

- Colonoscopy simulator validation is underway using EVMS medical students and residents

Ongoing Validation Studies:

- Validation studies of an arthroscopic simulator are ongoing with the Naval Regional Medical Center -Portsmouth